Reservoir Compartmentalization and Architecture of a Fine-Grained Turbidite System: Lower Triassic Montney Formation, Alberta

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ABSTRACT

The Lower Triassic Montney Formation of west-central Alberta has been widely recognized as the first and only documented turbidite reservoir in the Western Canada Sedimentary Basin. First discovered and exploited in 1993, the Montney turbidite trend has yielded over 1.5 TCF of gas, plus liquids, and continues to be an active and expanding exploration play. Extensive well and core control provides the basis for constructing a sequence stratigraphic framework and reservoir architecture of these fine-grained sandstone turbidites. Within the lowstand systems tract of the mid-Montney, turbidite channel, lobe/sheet-sand and levee-overbank facies associations are recognized. Reservoir quality and heterogeneity of these facies are predominately a product of hydrodynamic processes of deposition. Subregional syn- or post-depositional extensional tectonism is recognized as playing a significant role in the distribution, over-thickening and orientation of turbidite reservoir facies.

In west-central Alberta, a distinct ramp-"edge" or break-in-slope trends north-northwest/south-southeast and defines the up-dip depositional limit of turbidite facies. The ramp-edge orientation is fault controlled and marks the onset of rapid and abrupt thickening of lowstand facies associations that comprise the principal reservoir trends in the Valhalla-LaGlace and Sexsmith fields. Due to the up-dip headward retreat of turbidite channels, the ramp-edge is highly modified by mass-wasting processes. Turbidite channels coalesce down-dip towards the base of slope and then grade into turbidite lobes basinward. Turbidite channels are associated with significant lateral discontinuity along depositional strike due to cross-cutting and have greater continuity along dispositional dip. Turbidite channel facies associations can be amalgamated to a thickness of up to 30 m, due to syn-sedimentary tectonism within localized grabens or half-grabens.

The distribution of levee overbank or channel-margin facies associations constrains the width of turbidite channels to a few hundred meters. In addition to inferring proximity, a levee-overbank facies association can be used to infer the direction of the associated turbidite channel through dip-meter log patterns. Turbidite lobes have a broad aerial extent, up to 10 km^2 in size, occur at the down-dip depositional limit of turbidite facies deposition and thin and grade basinward to shaly siltstone.

Recent investigations of modern and ancient fine-grained turbidite systems provide the best architectural models for Montney reservoir trends. Reservoir compartmentalization is recognized to be a function of lateral facies variability, net to gross sand/silt ratios, syn-depositional tectonism and antecedent depositional relief.